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SURVEY OF ENVIRONMENTAL MONITORING PROGRAMS IN MANITOBA

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Chairman's Message

Many important environmental changes are gradual and imperceptibly slow. In some cases, we do not recognize that a change has occurred until we discover an impact on human health or economy. An example might be the discovery of high levels of mercury in the tissues of fish upon which people depend for food. The question then often is has there been an environmental change or are we experiencing a natural condition? If a change has occurred, how great has the change been, how long has it been in operation and how rapidly is the change occurring. Long-term, comprehensive records of measurements of environmental variables are almost the only reliable way of answering these questions. This long-term environmental monitoring must occur in pristine areas as well as localities in which we expect "pollution problems". Detection of change implies a difference between present levels of a chemical or parameter in the environment and "background" or natural levels as measured in the pristine areas. We must also know how much natural parameters vary over time so that we do not incorrectly attribute a perceived change to an anthropogenic activity when it is really natural variability.

Recognizing the importance of environmental monitoring, the Environmental Chemicals Committee of the Manitoba Environmental Council in 1982 began a survey of the programs of chemical monitoring in place within Manitoba in order to support and perhaps make suggestions concerning environmental monitoring. This report is the result of that study and describes programs operated by provincial, municipal and federal agencies and branches. Environmental monitoring programs operated by industry are not included here.

We hope that this survey provides useful information to the public and increases awareness within monitoring agencies of the activities of other bodies. But most importantly, we desire that this effort underscores the importance of environmental monitoring and provides a basis for enhancing its effectiveness.

Dr. Atish C. Maniar
Chairman
Manitoba Environmental Council

September, 1984

INTRODUCTION

This survey was undertaken by the Environmental Chemicals Committee of the Manitoba Environmental Council to inform the Council of current government environmental chemical monitoring programs in Manitoba. By monitoring we mean surveillance of air, water, soil and biota, samples of which are collected and analysed for chemical pollutants. The surveillance may be performed routinely to comply with regulations under environmental legislation such as the Clean Environment Act or carried out for shorter periods of time to investigate specific pollution problems. During June, July and August of 1982, the senior author arranged and conducted informal interviews with personnel of the Environmental Management Division of the Manitoba government, other provincial government departments including the Department of Agriculture and the Department of Natural Resources, various federal departments including Agriculture Canada, Health and Welfare Canada, Environment Canada and Fisheries and Oceans, and with the City of Winnipeg. A complete list of acknowledgements is given on page 27. Generally, departments were questionned on their contacts with other agencies, the use of laboratory facilities, recently conducted monitoring programs, and those environmental parameters requiring additional monitoring. Monitoring by private industry was not considered here.

In January 1984 the report was sent to all the agencies which originally participated in 1982 with the request that any errors or omissions be corrected. Replies were received from all participants and a meeting was held with senior Environmental Management Division personnel to update the report.

Recent issues surrounding chemical monitoring in Manitoba include the measurement of insecticide residues following mosquito control programs, and of toxic or foul-smelling emissions from industry. The monitoring of contaminants such as these is an essential part of environmental management programs. Often, the public will request chemical monitoring, yet few individuals are aware of the extent of existing programs, or of the kinds of information such monitoring may provide. This report is intended to inform the members of the Environmental Council, as well as the general public, of current monitoring capabilities.

This report is organized from an environmental perspective around four basic compartments, water, air, soil, and biota in order to emphasize their interrelationship and their contributions to a whole - the biosphere. Contaminants released into the environment in the course of human activities reverberate around this whole and can be measured in one or more of the above compartments until such time as they decay to harmless products, are diluted below limits of detection or are sequestered and immobilized by natural processes. In addition, monitoring of precipitation, ground water, vegetation, food, workplace and hazardous wastes was included.

The authors and members of the Environmental Chemicals Committee have drawn a number of conclusions and recommendations from the findings which are listed on pages 19 to 26.

SOURCES OF ENVIRONMENTAL CONTAMINATION IN MANITOBA

One possible source of environmental contamination is hazardous wastes. The net volume of hazardous wastes produced in Manitoba is relatively small, representing approximately 17% of the total hazardous wastes generated in northern and western Canada, or about 42,000 tonnes annually (Reid-Crowther, 1980). Approximately 90% of these wastes are produced in the City of Winnipeg, while northern and southern Manitoba contribute about equally to the remaining 10%.

According to the Joint City-Provincial Task Force for Hazardous Waste Disposal (Lacey et al. 1981) Winnipeg generates approximately 12,853,000 litres of liquid waste and 76 tonnes of solid waste annually (Table 1). The city has had an industrial waste control program since 1957 and under this program, industries are required to treat their effluent in compliance with the Industrial Waste By-Law. Carbide lime, a by-product of acetylene production is presently being landfilled, some waste oil is recycled as fuel, and acidic and alkaline wastes are neutralized and discharged to the sewer. Low level radioactive wastes generated by hospitals and research laboratories present disposal problems. During the late 1970's these wastes were released into City of Winnipeg sewage lagoons. This procedure was discontinued and the wastes were burned at a landfill site until January 1984 when a decision was made to send low level wastes to Chalk River, Ontario.

The long term disposal of radioactive wastes, flamable solvents, toxic chemicals and sludges using landfill sites or waste treatment plants is no longer considered adequate. Consequently, the Task Force recommended the installation of an incinerator for the proper disposal of flammable solvents and other hazardous wastes for which incineration is the recommended method of disposal.

Another possible contaminant source, the use of pesticides, is an important concern for Manitoba. About 75% of Canada's agricultural production occurs in the three prairie provinces. Consequently, large quantities of herbicides and insecticides are used in this area annually. Of 200 chemicals recommended for agricultural use on the prairies, only 25 receive extensive use. The most widely used of these chemicals include the herbicides, 2,4-D, bromoxynil, dicamba, MCPA, trifluralin and triallate (Smith, 1982), and the insecticides, methomyl and lindane (Peden et al 1982). There has been no systematic monitoring of the effects of pesticides following their routine use each year in Manitoba. Should such a program be initiated those habitats associated with agriculture on the prairies of major concern would include: wetlands, rivers, lakes, dugouts, roadsides, improved pastures and croplands. A more localized problem concerns the use of Baygon (propoxur) and malathion in the aerial spray program to control mosquitoes carrying Western Equine Encephalitis, and their possible environmental effects.

The well-documented, adverse effects of industrial sulfur dioxide missions are another major environmental concern. Smelters at Flin Flon and

Thompson represent major local sources of acid-producing sulfur dioxide, which is potentially harmful to acid sensitive areas of northwestern Manitoba. Similarly heavy metal emissions, such as nickel, copper, and lead, from metal smelters have been found to have detrimental effects on the ecosystem. The ecological problems resulting from both acid deposition and metal discharges are compounded by the long-range atmospheric transport of these pollutants.

MONITORING PROGRAMS

I. WATER

1. Environmental Management Division, Province of Manitoba

a. The Water Pollution Control Service (WPCS) is responsible for protection of water quality in the province of Manitoba excluding Winnipeg. It provides technical advice to the Clean Environment Commission (CEC) and the Department of Health on the construction of public water systems, waterworks and sewage systems. Plans and specifications are reviewed to assess environmental impact and recommendations for limits by the WPCS are made to the CEC. Facilities are inspected during construction and start-up. Once built, public water supplies are monitored by public health inspectors. The WPCS may suggest which pollutants are to be checked. In the case of the Selkirk water supply from the Red River, the WPCS continuously monitors the chlorine level. Discharges to surface water and soil are monitored routinely from industries and water treatment plants and randomly from municipalities and rehabilitated mines. In addition, WPCS responds to public complaints and concerns.

b. The Water Standards and Studies Service (WSSS) is responsible for surface water quality. Samples are taken from a network of 83 sampling stations on a routine basis (Appendix 1). Samples from the 56 southern stations are taken monthly at times depending on the flow. Samples from the 27 northern stations are taken three times in the summer and three times in the winter. Site specific investigations are carried out in response to particular aquatic problems. The number of sites and specific parameters monitored are as follows:

79 for temperature, total and fecal coliform, conductivity, non-filterable residue, pH, dissolved oxygen, total organic carbon, total inorganic carbon, total Kjeldahl nitrogen, nitrate - nitrite, and total phosphorus;

17 for heavy metals including arsenic, cadmium, copper, lead, nickel, zinc;

and 40 for mercury.

Other WSSS programs in recent years include: a thirty-five lake survey conducted in 1981 to evaluate surface water sensitivity to acid deposition and a current study investigating the relationship of abandoned mine tailings on surface water quality at Cold Lake. Water quality surveys have also been conducted on other lakes: God's, Snow, Wekusko, Trout, Cliff, Herblet and Rice Lake.

c. Inspection Services has the responsibility of ensuring that the quality of water supplies provided to the public are in compliance with the regulations under the Public Health Act and the Clean Environment Act. All public water supply systems (Appendix 2) are inspected and sampled regularly (the larger the system the more frequently it is sampled). Water is analysed for arsenic, cadmium, lead, cyanide, bromide, mercury, chromium, fluoride, sodium, nitrates, pH, calcium, magnesium, iron, chloride, sulfates, copper, zinc, alkalinity, hardness and conductance. Water is also analysed for coliform bacteria weekly in Winnipeg and larger communities and biweekly in other public water systems. Inspection Services provides assistance, when requested, for sampling and analysis of private water supplies.

2. Environment Canada

a. The Environmental Protection Service (EPS) monitors industrial water pollution by means of a water pollution control program. It shares responsibility with the Province for monitoring the effluent discharged by mining, the pulp and paper industry, fish processing, potato processing, metal finishing, the oil refineries, and meat and poultry plants. Samples are analyzed at the Ward Provincial Laboratory or at EPS facilities in Edmonton. EPS also conducts site specific studies in cooperation with the EMD and other departments, for example monitoring of PCBs at a meat packing plant and in the Pembina River during the late 1970's.

b. The Inland Waters Directorate (IWD) of Environment Canada monitors potential pollution problems at 19 interprovincial and international stations, including three ocean going stations, in the province of Manitoba (Appendix 1). All stations are sampled monthly except four northern sites which are monitored quarterly. Between 40 and 80 chemical and biological constituents are tested at some stations including major ions, nutrients, heavy metals and biocides (Appendix 3). Testing parameters are not the same at all stations. Biocides and heavy metals are analysed at only 9 stations. Until 1982 all samples were sent to Calgary, Alberta for analysis. As of 1983 samples were sent to Burlington, Ontario.

In addition to the routine monitoring program, special studies are done on particular problems such as nutrient quality of rivers entering Manitoba, nitrogen and phosphorus levels in the Red River, and the water quality of the Souris River.

As a result of the concern with the Garrison Diversion project, a Continuous Water Quality Monitoring program was begun in 1978 and cancelled in

1982. Two sampling stations were used, one at Emerson on the Red River and one at Coulter on the Souris River, to monitor dissolved oxygen, pH, conductivity, chloride, temperature, total phosphorus and dissolved and total nitrogen. As of Jan. 1984 sampling was continuing at Emerson.

The IWD has representatives on the Red River Water Pollution Control Board, an internationally constituted committee including members from the EMD, Environment Protection Service and U.S. agencies. When a spill occurs near the international border all agencies are contacted and monitoring on a continuous basis is started.

3. City of Winnipeg

a. The Waterworks Waste and Disposal Department (WWDD) of the City of Winnipeg supplies technical services for water supply and wastewater treatment operations. The Laboratory Services Branch is responsible for monitoring the city water supply, wastewater treatment plants, rivers and streams in the Greater Winnipeg area. The WWDD routinely monitors effluents from industries within the city four times a year on three consecutive days. Suspect industries are monitored more frequently. Routine wastewater analyses include pH, dissolved oxygen, total organic carbon, biochemical oxygen demand, suspended solids, grease, heavy metals, nitrates, phosphates, carbon dioxide, methane, oxygen, chloride, sulfate and total Kjeldahl nitrogen.

Prior to disposal, sludges from the wastewater treatment processes are routinely analyzed for the heavy metals, cadmium, nickel, lead, copper, chromium, zinc and occasionally for sodium, potassium, calcium, magnesium, manganese and iron. The Laboratory Services Branch is also capable of analysing nutrients in sludge-treated soils.

The City of Winnipeg's drinking water supply from Shoal Lake is monitored bi-weekly for plankton, threshold odor #, pH, total alkalinity, hardness, turbidity, conductivity, suspended solids, color, total and dissolved organic carbon, total and free chlorine residues, chlorine demand, ammonia, nitrates, organic nitrogen, phosphates, phosphorus, fluoride, trihalomethanes, metals and asbestos. In addition, a survey of Shoal Lake water quality is conducted monthly from May to October at 12 sites on Shoal Lake (Appendix 4). Water samples are analyzed for temperature, dissolved oxygen, transparency, turbidity, threshold odor #, total and dissolved ortho phosphorus, chlorophyll(a), and total organic carbon. Summer water quality surveys are also conducted at the Deacon reservoir for total and fecal coliform, standard plate count, transparency, turbidity and chlorophyll(a).

The water quality of rivers within the city is monitored at six sites on the Red River, three sites on the Assiniboine River and seven locations on smaller streams (Appendix 5). Samples are collected biweekly all year (Red and Assiniboine). Water analyses include temperature, dissolved oxygen, pH, total and suspended solids, turbidity, total organic carbon, total coliform, fecal coliform, nitrate nitrogen, and total phosphorus. Streams sampled in

the city, including the Seine and LaSalle Rivers, Sturgeon Creek, Omand's Creek and Bunn's Creek, are also monitored in summer.

Chlorine turbidity and fluoride levels in the city's water supply are monitored through a Distribution Monitoring Survey (Appendix 6). Water samples are collected at 18 sites within the City, biweekly in summer and monthly in winter.

II. AIR

1. Environmental Management Division, Province of Manitoba

a. The Air Pollution Control Section (APCS) of the Environmental Management Division is responsible for enforcing the Clean Environment Act as it relates to atmospheric pollution. It conducts activities to ensure compliance with the Act and the Orders thereunder. APCS does an assessment of industrial emitters and makes recommendations to the Clean Environment Commission. Once an order has been issued, APCS inspects the industry at least twice yearly for odors, visible emissions (opacity), particulates and noise. In addition, it responds to citizen's complaints and attends CEC hearings on request. Environmental officers can recommend changing of laws and regulations if necessary.

A specialized team at the APCS carries out stack sampling between May to October to determine emission levels of particulates and gaseous pollutants by industrial operations. Emission surveys are carried out in triplicate to determine whether a company is in compliance with its CEC order. Alternatively, companies may hire consultants to do testing under observation by APCS.

APCS does indoor community monitoring on a complaint basis in cooperation with Public Health Inspectors. It will test for pollutants in private homes (e.g. furnace gases, ozone, etc.) and was involved in testing formaldehyde levels in buildings insulated with urea formaldehyde foam until February 1982.

An Incinerator Regulation regulates the quantity and opacity of emissions from incinerators in the province. Incinerators inside the city core are the responsibility of the City of Winnipeg and are governed by city By-Laws, those outside the city core and in the rest of the province are the concern of the APCS.

b. The Air Standards and Studies Branch (AS&S) of the Environmental Management Division monitors air quality through three programs:

(i) The National Air Pollution Surveillance Program (NAPS) is a federal/provincial program designed to monitor and assess on a continuing basis the quality of the ambient air in the urban regions of Canada. Fifty-nine stations are monitored nationally. The federal government coordinates the NAPS program and provides monitoring equipment for the sampling stations operated by the provincial government. There are two class I stations (representative of long term population exposure air) and three class II stations (temporary for monitoring specific pollutants) in Winnipeg and one class II station in Brandon (Appendix 7).

In Winnipeg, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide and soiling index are monitored continuously, and hourly averages are recorded. Lead, sulfates, nitrates, and total particulates (as 24 hour averages) are monitored in Winnipeg and Brandon on a six-day basis. Dustfall and sulphation rate are measured as thirty day cumulative samples. Monthly reports are compiled and available from AS&S or from the Air Pollution Control Directorate of Environment Canada.

(ii) The Impingement Monitoring Program provides for the continuous monitoring of the ambient air at ground level downwind of specific industries to determine impact on air quality and in some cases in order to determine compliance with CEC orders. Currently the areas (and pollutants) monitored include the following: St. Boniface oil refinery in Winnipeg (no longer in operation as of Sept. 1983 (SO_2, H_2S)), Brandon (SO_2, O_3, soiling index total particulates, Pb, SO_4, NO_3, NH_4OH, NO_2) two sites at the Flin Flon metal smelter (SO_2), the pulp mill at the Pas (H_2S), and the metal smelter at Thompson (SO_2).

(iii) In addition to the continuous monitoring network, AS&S conducts special short term investigations and responds to some environmental emergencies using a mobile lab. Current special projects include studying ammonia levels in the air from fertilizer operations in Brandon and fluoride levels in the air at a brick processing plant near Lockport.

The AS&S also provides support services for other governmental agencies. It is involved in setting air quality objectives and is presently investigating acceptable levels for odors, and sulfuric acid mist. Modelling programs are being developed to determine the dispersion of hazardous chemicals in the event of an accidental leak (e.g. ammonia spill in Brandon). This section also performs air dispersion monitoring to predict concentrations of pollutants in the air which might be associated with certain emission sources.

2. Environment Canada

The Environmental Protection Service monitors emissions from secondary lead smelters in Winnipeg to ensure they comply with federal regulations. No regulations have been set by the federal government for sulfur dioxide emissions from secondary lead smelters.

EPS randomly surveys service stations, producers and storage facilities throughout the province to ensure that gasoline does not contain excessive levels of lead and phosphorus.

III. PRECIPITATION

1. Environmental Management Division, Province of Manitoba

a) The Terrestrial Standards and Studies Section (TSS) has carried out a number of studies to evaluate precipitation for air pollutant deposition from northern mining smelters as part of a federal/provincial program. Studies of summer rainfall and winter snowfall were designed to provide information on heavy metal deposition and accumulation in the forest ecosystem in the vicinity of Thompson and Flin Flon. A network of precipitation samplers were established to provide information on total deposition (wet and dry fall). Twelve sites in the Thompson area and 7 sites in Flin Flon were monitored at 4 week intervals between 1979 and 1983. An experiment to measure event precipitation was carried out within a 5 km radius of the northern smelters in 1980 and within 2 km in 1981. The results obtained were inconclusive in defining a relationship between precipitation pH and distance from the smelters, but did provide information on metal deposition.

In 1979 a snow monitoring network was established at the same 12 sites in Thompson and 7 in Flin Flon and continues to date. Snow samples are collected 3 times per year and analyzed for pH, zinc, nickel, lead, cadmium, copper and iron. In addition, a subsample is analyzed for all parameters related to precipitation quality to evaluate the potential occurrence of acidic deposition. Further, in 1981, the snow monitoring network was expanded to an additional 18 sites throughout the province to evaluate the potential for acid rain or the long-range transport of air pollutants. At present (Jan. 1984) there are a total of 37 snow sampling sites routinely monitored during January, February and March.

b. The Air Standards and Studies Service (AS&S) maintains a daily acid rain monitoring program. The AS&S is investigating the quality of precipitation at five sites in northern and eastern Manitoba: Norway House, Island Lake, Point Dubois, Gillam and Brochet. Precipitation is collected and analyzed for pH, acidity and major ions including: SO_4, NO_2, Ca, Mg, Na, Cl and K as sample volume allows.

IV. GROUNDWATER

Monitoring of groundwater is not done on a routine basis by any governmental agency. The Waste Management Service of the Environmental Management Division will test groundwater if contamination is suspected. The Water Pollution Control Service monitors groundwater in special programs. For example, in Roblin, Manitoba an agricultural irrigational system is being

developed, consequently groundwater is monitored for leaching of materials from the soil.

The ground water section of the Department of Natural Resources samples selected aquifers in Manitoba for coliform and water quality parameters.

A special project conducted by the Environmental Management Division and the Department of Natural Resources involves monitoring ground water in eastern Manitoba for alpha and beta radioactivity to determine if Guidelines of Canadian Drinking Water Quality are exceeded. Specific tests for Ra226 and chemical uranium are also done.

V. BIOTA

(A) Fish

1. Environmental Management Division, Province of Manitoba

The Water Standards and Studies Section (WSSS) has been biomonitoring selected rivers in the province since 1978. Four rivers are sampled monthly during the open water season: the Red River (at three sites), the Assiniboine River (at two sites), the Souris River (at one site) and the Winnipeg River (at three sites). Samples are collected to study the populations of benthic organisms. The accumulation of heavy metals and organics in fish and sediments is also determined.

2. Fisheries and Oceans (DFO)

The Fish Inspection Division of this department routinely monitors commercial fish from Lake Winnipeg, northern Manitoba and Saskatchewan lakes. The chemistry section of DFO at the Freshwater Institute will monitor fish for contaminants in the event of a pollutant spill.

(B) Wildlife

1. Environmental Management Division, Province of Manitoba

The Terrestrial Standards and Studies Section (TSS) of the EMD is conducting a series of studies aimed at determining the level of environmental quality by measuring, documenting and attempting to predict changes indicative of adverse environmental impact in wildlife communities. Areas of research include:

(i) Heavy Metals - Since 1977, small mammals have been captured in the vicinity of the Thompson and Flin Flon smelter areas to determine the level of metals in their tissues. Each year animals are collected and analyzed for lead and cobalt in muscle and bone tissue. Skin and hair are analysed for arsenic, nickel, copper and zinc. Those metals present in negligible amounts or known to be non-toxic are not monitored. Results indicate that in general tissue concentrations of heavy metals increase with increasing proximity to the smelters. In 1977 and 1979 blood hemoglobin concentrations were monitored and were found to increase with greater proximity to the smelters. Results of this program were submitted to the CEC hearings into the two smelters.

(ii) Mercury - Tissues of fish-eating mammals (otter and mink) are being collected from trappers for mercury analysis. Animals are analyzed for inorganic mercury in liver and kidney tissues and for the accumulation of organic mercury in brain tissue. Samples are collected in different watersheds every year. TSS is also participating in mercury studies under a Federal-Provincial agreement in the Churchill River diversion area.

(iii) Lead Survey - A city-wide survey was conducted with the cooperation of 16 Winnipeg veterinary clinics to establish lead levels in the blood of dogs since these levels closely approximate those expected in children. A report was released in 1983.

(iv) Pesticide Bibliography - A previously published bibliography of the effects of pesticides on wildlife is being updated. Areas of concern that require study as suggested by the TSS include pesticide levels in farm dugouts and the effects of Baygon spraying on non-target organisms.

(v) Hazardous Wastes - Between 1976 and 1979, the TSS studied the utilization of trash dumps for food and shelter by wildlife species. It is estimated that approximately one half of the mammal and one third of the bird species of Manitoba may be represented at these dump sites.

(vi) Fluoride Monitoring - Concern over the possibility of an aluminum smelter being located in the province in 1982 resulted in a study to determine background levels of bone fluoride in deer. Deer were used as they closely approximate cattle. Samples of bone from available road killed deer in the Bird's Hill - Lockport area were analyzed.

(vii) Pesticide Monitoring - Blood from native bird populations was monitored for antibodies of the virus for Western Equine Encephalitis in 1983. Birds were also collected for analysis of brain chlolinesterase during the aerial application of malathion to control mosquitoes in 1983.

VI. SOIL

1. Department of Agriculture, Province of Manitoba

The Soil Testing Laboratory (STL) analyzes soil samples (and occasionally plant tissues) from farmers for heavy metals on request. At present, it

receives approximately 500 samples per year and expects this to increase to 3000 with greater public awareness. STL will test soil to determine levels of contaminants, necessity of soil removal and agricultural usability of soil. Approximately 100 samples per year are analyzed for the oil industry for reclamation of land around drilling sites. Samples have been examined for Trans-Canada pipelines to determine the agricultural value of land, or in the case of a claim or spill.

2. Environmental Management Division, Province of Manitoba

The Terrestrial Standards and Studies Section (TSS) of the EMD has been monitoring lead-in-soil in areas of secondary lead smelters and areas of varying traffic volume in Winnipeg since 1979. In 1981, EMD adopted a guideline for lead-in-soil in areas which may be frequented by children. If lead levels in soil are 3000 ± 13% or 2600 ppm or greater the Division recommends removal or removal and replacement. As a result of monitoring in the Weston area, sod and soil were removed and replaced on 26 residential properties in 1982 and on 405 metres of boulevard in 1983. In addition, soil, dust and particulate debris were removed from a paved playground at Weston Elementary School in 1981 and 1983. Lead-in-soil surveys were extended in 1983 to include 7 Winnipeg schools adjacent to major traffic arteries and 3 established residential areas. As well, lead-in-soil surveys took place in the cities of Thompson and Flin Flon and are planned for Brandon, Portage La Prairie, Dauphin, Swan River, The Pas, Selkirk and Steinbach in 1984.

Since 1977, TSS has been studying the effect of atmospheric emissions from the Thompson and Flin Flon mining and smelting industries on forest soils. Soils are studied from a network of 12 sites in Thompson and 7 in Flin Flon within 60 km of both smelters. Metal deposition (lead, zinc, iron, copper, nickel, cadmium), is analyzed in surface organic soils and in mineral soil to a depth of 50 cm to determine contaminant deposition, accumulation and migration. Investigations of pollutant effects on soil respiration, soil leachate and seedling root growth have been carried out.

The use of soils in monitoring contaminant effects on the environment has been undertaken in a number of site specific studies by TSS. Concentrations of arsenic in soil near a warehouse in St. Pierre were monitored from 1979 to 1981. In 1979, soil was used as a receptor tc determine ambient emission concentrations of chlorine from a chemical plant in Brandon and for ambient fluoride concentrations from a brick manufacturing plant in Lockport.

During the period 1979 to 1982, surface soils in the Flin Flon area were used to monitor mercury and lead deposition and accumulation. In addition, a study of soils for wood preservative contamination was carried out at Roblin Forest Products Limited in Roblin during 1982 and 1983. Since 1982, TSS has fulfilled a consultative role in evaluating potential environmental impact to soils from spills in the petroleum industry and in the development of organic soil deposits (peat) in Manitoba.

VII. VEGETATION

The Terrestrial Standards and Studies Section of the EMD has been monitoring vegetation for environmental impact since 1976 through various studies, surveys and site specific investigations. Initial investigations between 1976 and 1978 evaluated coniferous tree foliage for determination of the effectiveness of aerial applications of pesticide for budworm control. Detailed studies were carried out in the Spruce Woods Forest and in the Belair Provincial Forest.

In 1977, a monitoring program for effects on forest vegetation from sulfur dioxide and heavy metal emission from northern mining smelters was initiated in co-operation with the Canadian Forestry Service. This program was in effect until 1983 and established study networks at both Thompson and Flin Flon where coniferous tree foliage, vascular plants, lichen and moss species were used to evaluate pollutant deposition and accumulation. Reports have been produced and submitted by TSS to the CEC at respective hearings since 1977.

Arsenic deposition in vegetable gardens was evaluated from 1979 to 1981 in St. Pierre. Mercury and lead deposition and accumulation on blueberry plants in the Flin Flon area was monitored between 1979 and 1982. Native tree seedlings of Mountain Ash, Manitoba Maple and Dogwood were used in transplant studies to evaluate the effects of chlorine emissions from a chemical plant in Brandon and fluoride emissions from a brick manufacturing plant in Lockport in 1979. Vegetation was also used to monitor effluent emissions from Spruce Point Mine at Reed Lake in 1980 and 1981.

Lead deposition and accumulation was monitored in the City of Winnipeg through surveys of tree foliage and studies of vegetable gardens from 1979 to 1981. In 1983 vegetable gardens were used to monitor the effect of the aerial spraying of malathion to control mosquitoes carrying Western Equine Encephalitis. A total of 12 gardens were sampled in the City of Winnipeg and 42 were sampled at 14 other towns and communities exposed to aerial spraying.

VIII. WORKPLACE

The Work Place Safety and Health Division, (Manitoba Dept. of Environment, Workplace Safety and Health) is responsible for monitoring health hazards in the workplace throughout Manitoba. The Work Place Safety and Health Act (1977) gives this department access to all areas of employment. Monitoring is done mostly on a complaint basis although occasional surveys are carried out in areas of concern. The division is consulted by institutions and industries on appropriate guidelines prior to construction. Safety inspectors visit the workplace and are in direct contact with the employees. Testing is carried out for levels of carbon monoxide, carbon dioxide, nitrates, solvent vapors, hydrocarbons, particulates and heavy metals as well as physical agents such as heat, stress, light, sound and radiation. The Ward Laboratory of EMD performs all analyses other than direct readings. Guidelines for acceptable

occupational exposures such as those of American Conference of Governmental Industrial Hygienists - Threshold Limit Values are consulted.

Special programs conducted in 1982 with the aid of summer students included studies of heavy metals in foundries in Winnipeg, mercury levels in dental offices, and a survey of noise levels in the province.

IX. FOOD

1. Department of Fisheries and Oceans

The Fish Inspection Division of this department is responsible for monitoring commercial fisheries for contamination. A sample of all fish imported or processed by the Freshwater Fish Marketing Corporation is tested. In the early 1970's surveys of lead, copper, cadmium, zinc, arsenic, selenium and pesticide levels were made. Presently only mercury is routinely monitored. Pesticides and heavy metals are tested for only if their presence is suspected. Those contaminants monitored include the pesticides DDT (and its metabolites), methoxychlor, hexachlorobenzene, hexachlorocyclohexane (HCH), dieldrin, heptachlor, aldrin and PCBs. Heavy metals most frequently monitored include lead, cadmium, copper and zinc. Occasionally, chromium, nickel, iron, manganese, magnesium, cobalt, arsenic and selenium levels are measured. In addition the Division monitors salt content and levels of colour additives in fish to ensure compliance with regulations. Analyses are done at the Freshwater Institute in Winnipeg.

2. Health & Welfare Canada

The Health Protection Branch (HPB) is primarily concerned with identifying and preventing exposure to health hazards associated with foods, drugs, medical devices, radiation, consumer products and the environment. The HPB prairie regional office and laboratories are located in Winnipeg. Two directorates of HPB work in the environmental area:

(i) The Environmental Health Directorate sponsors and provides the Secretariat for the Federal/Provincial Advisory Committee on Environmental and Occupational Health. The Advisory Committee was established, initially as a Sub-Committee, in 1974 to advise Ministers and Deputy Ministers of Health on all matters of environmental and occupational health. The committee suggests appropriate health actions for:

- contamination of food, air, water and land by physical, chemical, radioactive and other substances;
- urban, industrial and other waste disposal activities, effluents, and emissions;
- new chemical compounds and operational innovations;
- physical, chemical, radiation and other health hazards of work environments;
- personal health services provided at the work-place.

The Committee works through the following Federal/Provincial Committees:

1. Sub-Committee on Radiation Surveillance;
2. Working Group on Bioassay and In Vivo Monitoring Criteria;
3. Working Group on Wastewater Disinfection;
4. Working Group on Recreational Water Quality;
5. Working Group on Health and Safety of Laboratory Workers;
6. Working Group on Indoor Air Quality;
7. Working Group on the Development of Guidelines to Control Risks for Women in Industry;
8. Working Group on Drinking Water Quality;
9. Working Group to Prepare Guidelines for Occupational and Environmental Noise and Hearing Conservation.

Some of the activities carried out or underway by the committees entail:

- the formulation of recommendations, such as the control of pesticide hazards, environmental health in dockland areas, safety standards and control of lasers in public, sanitation in northern communities, etc.;

- the review of documents and data, such as, lead levels in blood, disposal of chemicals from schools, health effects of acidic precipitation, storage and disposal of waste materials, asbestos containing materials in public buildings, occupational respiratory diseases, labelling and disclosure of industrial chemicals, use of mercury in dental offices, radiation safety standards (microwaves, X-rays, lasers, tanning booths, video terminals, etc.), occupational health services for hospital staff, periodic health examinations in occupational health, compendium of analytical methods for drinking water quality, sanitation manual for isolated regions;

- the preparation for publication of the following Committee reports:

  • wastewater disinfection,
  • guidelines for health and safety of laboratory workers,
  • guidelines for uranium bioassay,
  • guidelines for radioiodine bioassay,
  • guidelines for indoor air quality,
  • guidelines for control risks to women in industry,
  • guidelines for occupational and environmental noise and hearing conservation.

ii. Field Operations Directorate, Central Region

Central regional office and laboratories located in Winnipeg serve the Field Operations program in Manitoba and Saskatchewan. District Inspection Services offices are located in Brandon, Regina and Saskatoon.

Under the authority of the Food and Drugs Act, inspectors inspect food processing and drug, cosmetic and medical device manufacturing plants, monitor ports of entry for defective products, investigate consumer complaints, sample marketed products, and where necessary seize or recall products which are unsafe.

Activities of the HPB laboratory in Winnipeg include analyses for the following types of chemicals:

(i) Food additives. Food is monitored for intentional (food coloring) and unintentional additives (toxins, extraneous matter). It provides technical assistance to Consumer and Corporate Affairs concerning cases of economic fraud (i.e. fat content, extraneous material).

(ii) Drugs. The HPB provides technical assistance to the Police department in drug identification. It also tests for confirmation of contents of legal drugs.

(iii) Chemical residues. Prior to 1980, food analyses were performed for pesticides and trace elements. HPB no longer monitors for heavy metals but sends suspect samples to Toronto for analysis. For most chemicals, tolerance limits are set and food is tested for compliance with these standards. Chemical residues tested for are pesticides, organochlorines, organophosphates, some organonitrates, PCBs, mirex and HCH. They are analyzed using multi-residue techniques. Bacteriological monitoring is also carried out. Food is tested for spoilage and bacterial counts.

3. Canadian Grain Commission

The Residue Analysis Section of the Research Laboratory Division of the Canadian Grain Commission operates a pesticide residue quality assurance program on commercial Canadian grain. The Commission is responsible for ensuring the quality of grain moving through the licensed grain handling system. Approximately 2500 cargo loading samples (wheat, barley, oats, rye and rapeseed) are sent to the Winnipeg head office for pesticide residue analyses each year and are screened for organochlorines, organophosphates, and organonitrogen compounds. Some herbicides are also investigated although most herbicides are used too early in the year to be of much concern for residues in harvested grain. Fumigated parcels (insect-infected grain that has been treated) are also isolated and sampled for insects and pesticide residues (discontinued in 1984). The Pesticide Residue Section also provides technical services to the Grain Inspection Division in analysis of suspect grain. Due to the concern over potential residues occurring in exports, the Commission also collaborates with the Plant Health and Plant Products Directorate of Agriculture Canada in the evaluation of new pesticides proposed for the grain industry.

4. Agriculture Canada

The Plant Health and Plant Products Directorate (PHPPD) of Agriculture Canada is responsible for the enforcement of the Pest Control Products Act. Any pest control product (herbicides, insecticides, fungicides, disinfectants, etc.) wishing to be imported and/or sold in Canada must first be registered under the Pest Control Products Act. Prior to registration being granted, the Pesticide Division of PHPPD (based in Ottawa) conducts a pre-registration review of data supplied by the registrant dealing not only with the active ingredient but also with the carrier and with any additives or contaminants (e.g. micro-contaminants like dioxins or nitrosamines) that may be present. PHPPD also monitors the use of the products and occasionally re-evaluates active ingredients such as when new information comes to light. The Department of Agriculture works closely with the Department of Health and Welfare, the Department of Fisheries and Oceans, and the Department of the Environment when considering registration of a new product or active ingredient re-evaluation.

Once a product is registered an approved label must be affixed to each container sold and it is the responsibility of the regional offices of PHPPD to ensure products are properly labelled and are not being misrepresented or misused. All pesticide labels are kept on microfiche and are examined for a satisfactory listing of contents, precautions and safe use. Also regional staff monitors the use and distribution of pesticides across international borders. They also investigate many complaints that arise from product misuse, product failing to meet its label guarantees, or mis-representation of product.

The PHPPD also takes livestock feed samples (under the authority of the Feeds Act) to monitor for a wide range of pesticide residues and carries out investigations when positive results are found.

5. Manitoba Department of Agriculture

The Entomology Section of the Manitoba Department of Agriculture in conjunction with the Pesticide Residue Testing Committee have been monitoring food products for chlorinated hydrocarbon insecticide residues since 1963. The purpose of sampling is to determine the source at the producer level and to correct and/or prevent contamination. Monitoring is a cooperative effort with the Food and Drug Division to reduce redundant sampling. Food samples are analyzed by the Agricultural laboratory at the Health Protection Branch Food and Drug Laboratory. The Division samples all Manitoba milk supplies twice yearly and randomly samples poultry, eggs, beef and pork.

Problems occasionally occur with elevated levels of lindane, toxaphene and DDT.

Pesticide safety training courses are provided to pesticide dealers and applicators. In the case of an insect infestation the Division will provide information and coordinate activities for control. It is involved in field surveys to determine the necessity of pesticide spraying.

6. Environmental Management Division, Province of Manitoba

The Pesticide Section (formed in 1983) is primarily involved with monitoring Clean Environment Commission Orders dealing with application of pesticides and enforcing pesticide regulations under the Clean Environment Act, i.e. meat inspection and food safety. Food testing is carried out as a follow-up to any complaints or concerns by the Department of Health. The Pesticide Section works with the Manitoba Department of Agriculture on the Committee for Pesticide Residue Testing. All food samples are analyzed by the (Federal) HPB laboratory, but it has testing capabilities for only 25% of the pesticides in use (mainly organochlorines, some phenoxyacids and organophosphates).

X. HAZARDOUS WASTES

1. Environmental Management Division, Province of Manitoba

The Waste Management Section operates an Environmental Accident Program to reduce environmental risks to soils, groundwater and surface waters by leaks and spills of hazardous materials on non-federal facilities. The Branch has emergency response capability. An emergency telephone number was installed in 1981 and two staff members are on stand-by 24 hours a day, seven days a week. When an accident is reported, the Division does an immediate assessment. It advises as to chemical hazards, makes recommendations to minimize and contain these hazards, and recommends any necessary evacuation procedures. Although the party involved in the spill is responsible for clean-up, the Waste Management Branch ensures that the clean-up is adequate. If contamination has occurred it conducts sampling and follow-up monitoring.

In 1981, the emergency response line received 163 calls, of which 146 involved the release of potentially hazardous materials. Of these calls, 90 were attributed to petroleum spills, 31 of which occurred during transfer operations and 11 during transport. Agricultural and other chemical spills accounted for the other 56 calls, half of which resulted from leakage of defective or damaged containers.

Waste Management personnel provide engineering assistance to municipal corporations in the establishment of new solid waste disposal sites, to ensure that they are established in areas where they will have a minimum impact on the environment (in compliance with Clean Environment Act Regulation 208/76). Follow-up inspections of established disposal sites are conducted regularly.

All gasoline storage tanks in the province are inspected and registered by the Waste Management Branch. Operators are required to record results of daily dip tests to determine that fluid volume changes are accounted for through consumption and not leakage.

A new Transportation of Dangerous Goods Act, dealing primarily with road transport and packaging of materials, was adopted by the federal government in 1981. Waste Management personnel are currently involved in preparing comparable provincial legislation.

Generally, industries dispose of wastes by commercial pickup vehicles. Some of these wastes go to landfills and some are discharged into the sewage system. The City of Winnipeg is responsible for monitoring its sewage while industries are responsible for monitoring their effluents. Under the Hazardous Materials Program, Waste Management personnel provide assistance in the handling and disposal of hazardous materials generated at schools, hospitals, government facilities, industries and by the public. The EMD operates an interim storage facility at Gimli, Manitoba for small quantities of toxic materials for which no acceptable methods of disposal are presently available in the province. Flammable or highly reactive wastes are not accepted. Disposal of wastes from this facility is arranged periodically as required using the services of commercial disposal companies. Materials that can be exploded are collected and taken to the Brady Land Fill site and detonated. Flammable solvents could be incinerated but no facilities are presently available.

2. Federal-Provincial Study of land fill sites.

The Environmental Protection Service & the Waste Management Branch of the EMD are cooperating on a study of operating and abandoned landfill sites. The study was initially involved in the identification of sites and their contents, and the evaluation of any potential environmental problems. Sites are then rated according to their degree of hazard. Phase two completed in spring of 1984, consists of site verification and on-site inspection for leaching, gas generation, etc. Phase three will involve remedial action.

SUMMARY AND RECOMMENDATIONS

1. Water

Water Pollution Control Service (EMD)

- provide technical assistance to the CEC in the building of public water supplies, waterworks and sewage systems
- routinely monitor effluent from industries and water treatment plants
- random monitoring of discharges from municipalities and rehabilitated mines
- ground water is inspected if a known discharge is entering it

Water Standards & Studies (EMD)

- water quality monitoring program - 83 sites throughout Manitoba (samples 6 - 12 x per year)
- relationship of abandoned mine tailings on surface water quality (i.e. Cold Lake)

Inspection Services (EMD)

- all public water supply systems are monitored quarterly (bacteriological sampling bi-weekly). Winnipeg water is sampled weekly for bacteriological analysis

Environmental Protection Service (Environment Canada)

- monitor effluent discharged from industries once yearly

Inland Waters Directorate (Environment Canada)

- monitor water quality at 19 international and interprovincial stations in Manitoba (sampled 4 - 12 x per year)
- biocides and heavy metals monitored at 9 of these stations
- continuous water quality monitoring program on Red and Souris Rivers

Waterworks, Waste & Disposal Department (City of Winnipeg)

- monitor effluent from industries within the city 4 x per year
- monitor sludges from wastewater treatment plants for heavy metals

- monitor quality of Winnipeg drinking water bi-weekly
- water quality survey of Shoal Lake is conducted monthly from May - October
- monitor water quality of the Red, Assiniboine Rivers and small streams in Winnipeg
- monitor chlorine levels in city water supply

Recommendations/Comments

Increased monitoring of industrial effluent to determine constituents is required. Chemicals monitored in water should reflect known inputs identified by hazardous waste inventories for Manitoba (Atkinson and Siemienuik, 1980) or the City of Winnipeg (Lacey et al. 1981). For example flammable solvents, dry-cleaning solvents, waste petroleum hydrocarbons (polynuclear aromatics and aliphatic hydrocarbons) are not routinely monitored although they are major liquid wastes.

Although some biocides, particularly chlorinated hydrocarbons, are being monitored, these are not the chemicals most commonly used. Pesticides monitored should reflect those commonly used: 2,4-D, bromoxynil, dicamba, MCPA, trifluralin, triallate, methomyl,lindane and pentachlorophenol. Quantities of asbestos in City of Winnipeg drinking water should be comprehensively surveyed at many user-locations throughout the city and should be monitored over time.

While the EMD laboratory is capable of a wide variety of analyses of chemicals in water (Appendix 8) there appears to be limited capability to identify unknowns especially of organic chemicals. In this regard, the EMD should consider purchase of a gas chromatograph-mass spectrometer to identify unknown volatile organic chemicals.

2. Air

Air Pollution Control Section (EMD)

- assess potential atmospheric pollution of industries, prior to construction
- industries monitored twice yearly for odors, opacity, particulates and noise
- random monitoring of stack emissions between May - October
- indoor community monitoring is done on a complaint basis.

Air Standards and Studies (EMD)

- NAPS program, continuously monitor ambient air quality in Winnipeg and Brandon
- Impingement monitoring program - continuous monitoring of emissions downwind of specific industries
- conduct short term investigations and respond to emergencies

Environmental Protection Service (Environment Canada)

- supervise sampling of emissions from secondary lead smelters in Winnipeg (1-2x per year)
- randomly sample gasoline tanks to determine levels of lead and phosphorus in gasoline

Recommendations/Comments

Little or no monitoring is done of organic contaminants in the air. Background levels of compounds such as dioxins and polyaromatic hydrocarbons on particulates in the air should be obtained. This is urgently required because increased use of wood burning in urban areas may have resulted in emission of these compounds into the air. Background levels of organic materials would be needed for reference as additional potential sources of pollutants to air, such as a waste-burning incinerator in Winnipeg or an aluminum smelter.

Additional cooperative effort between agencies should be made to determine the sites of deposition of the large amounts of SO_2 emitted from Manitoba's metal smelters.

3. Precipitation

Terrestrial Standards and Studies (EMD)

- monitor sulfur dioxide and heavy metals emitted from mining smelters in northern Manitoba, through such programs as: snow monitoring, event rainfall sampling, total deposition monitoring (prior to 1983)

Air Standards and Studies (EMD)

- monitor the quality of precipitation at 5 sites in northern Manitoba

Recommendations/Comments

The precipitation monitoring program should be expanded to include other sensitive areas.

Areas of concern might include:

- Flin Flon, in the vicinity of the mining smelter
- Winnipeg, in the vicinity of secondary lead smelters and in areas of high traffic volume.

4. Groundwater

There is no systematic monitoring of groundwater in Manitoba, although the Department of Natural Resources does carry out water quality measurements on some aquifers.

Recommendations/Comments

Considering its abundance and value as a resource, action should be taken to preserve the quality of groundwater in Manitoba. As a result of the nature of groundwater, contamination would have far-reaching effects and would be very difficult if not impossible to correct. Particular attention should be given to areas where aquifers are close to the surface and/or areas of porous soils. Monitoring of groundwater should be carried out in areas predisposed to leaching, landfill sites containing either wastes and/or toxic chemicals, agricultural areas with high usage of chemicals, areas of industrial discharge and in areas where accidental leaks or spills of toxic chemicals occur.

5. Biota

Fish

Water Standards and Studies (EMD)

- biomonitoring of phytoplankton, zooplankton, benthos and fish in the Red, Assinboine, Souris, and Winnipeg Rivers monthly during the open water season

Fish Inspection (Fisheries and Oceans)

- routinely monitor commercial fish species

Wildlife

Terrestrial Standards and Studies (EMD)

- monitoring heavy metal concentrations in the tissues of small mammals in the vicinity of mining smelters in northern Manitoba
- monitoring mercury levels in tissues of aquatic carnivorous mammals from the Burntwood, Whiteshell and Winnipeg Rivers
- survey of lead concentrations in the blood of pet dogs in Winnipeg
- monitoring wild birds for antibodies to the WEE virus
- monitoring levels of bone fluoride in road killed deer

Recommendations/Comments

Biomonitoring of terrestrial and aquatic animals and vegetation for heavy metals and pesticides should be continued. Chemicals tested, particularly pesticides, should reflect those most commonly used.

Consideration should be given to accumulative and long term effects as a result of bioaccumulation of pesticides and heavy metals. Follow-up testing of representative flora and fauna after application of chemicals (i.e. Baygon) should be initiated.

The use of dump sites by animals for food and shelter can have widespread implications in terms of the number of animals affected and the dispersion of wastes. This program which was completed in 1978 should be continued.

6. Soil

Soil Testing Laboratory (Manitoba Department of Agriculture)

- analyze soil samples for heavy metals on request.

Terrestrial Standards and Studies (EMD)

- monitoring lead levels at 8 stations in the City of Winnipeg
- monitoring soils for concentrations of various pollutants, eg. arsenic in soils in St. Pierre, Manitoba, fluoride from brick manufacturing in Lockport
- monitoring the effect of atmospheric emissions from the northern mining and smelting industries on forest soils

Recommendations/Comments

Areas of porous soils in close proximity to acquifers should be monitored for chemical residues and accumulation of heavy metals.

7. Vegetation

Terrestrial Standards and Studies (EMD)

- monitoring of effects on forest vegetation from SO_2 and heavy metal emissions from metal smelters
- site specific studies of vegetation eg. arsenic on vegetables in St. Pierre, malathion in gardens, lead deposition in Winnipeg

8. Workplace

Workplace, Safety and Health

- monitor health hazards in the workplace mostly on a complaint basis

9. Food

Fish Inspection (Fisheries and Oceans)

- monitor all commercial fish imported or processed by the Freshwater Fish Marketing Corporation for mercury. Pesticides and heavy metals are tested if suspected

Health Protection Branch (Health and Welfare Canada)

- monitor fruit and vegetables at all retail food outlets for food additives, drugs, chemicals (organochlorines) and bacteria
- monitor food products on the retail market for toxins, vinyl chloride monomers and additives

Pesticides Residues Section (Canadian Grain Commission)

- monitor all grain handled in the licensed grain handling system for pesticide residues (organochlorines, organophosphates and organonitrogens)

Plant Health and Plant Products Directorate (Agriculture Canada)

- monitor use and labelling of pesticide chemicals after registration

Entomology Section (Manitoba Department of Agriculture)

- monitor all Manitoba milk supplies twice yearly and randomly sample poultry, eggs, beef and pork at the producer level for chlorinated hydrocarbon residues

Pesticide Section (EMD)

- monitor CEC orders dealing with pesticide applications
- work with Manitoba Department of Agriculture on the Committee for Pesticide Residue Testing

Recommendations/Comments

Consideration should be given to those chemicals used most frequently (see text). Chlorinated hydrocarbons are no longer receiving widespread use, yet they continue to be monitored. For example, the Entomology Section (Manitoba Agriculture) is not capable of analysing most widely used pesticides, particularly insecticides such as dimethoate and carbofuran which may be applied to vegetable crops just prior to harvest.

10. Hazardous Wastes

Waste Management Section (EMD)

- responds to leaks and spills of hazardous materials
- engineering assistance to municipalities on new solid waste disposal sites
- storage of hazardous chemicals at Gimli

Environmental Protection Service (Environment Canada)

- cooperating with waste management section on a study of abandoned landfill site identification and inspection.

Recommendations/Comments

The development of a hazardous waste management program in Manitoba will mean increased need for monitoring of chemicals in industrial wastes and effluents. Leachates from landfills, both existing and abandoned sites, should be monitored once potential problem sites have been identified.

CONCLUSIONS

1. The Environmental Management Division of the Manitoba Department of Environment, Workplace Safety and Health carries out the largest monitoring programs for environmental chemicals in Manitoba. However, about 10 other provincial, federal and municipal laboratories are also involved in chemical monitoring. Government personnel interviewed expressed a desire for better communication about chemical monitoring programs of other agencies. Many of those interviewed expressed a desire to have the jurisdictions and responsibilities of the monitoring agencies examined to reduce overlaps and increase efficiency.

2. Water, air, precipitation, soil, vegetation, food products, hazardous wastes and biota are all monitored. Some areas, especially water, receive much more extensive analysis for chemical residues than others. Several interviewees acknowledged that sample sizes and sampling frequency were often inadequate. For example, most river water sampling (Appendix 1) is monthly, which is probably adequate for standard water quality measurements, but inadequate to follow sudden inputs of toxic chemicals from point sources. Monitoring agencies appeared to be functioning at their capacity in terms of person years and equipment available.

3. The laboratories of at least six agencies determine specific toxic contaminants (heavy metals and chlorinated hydrocarbon pesticides) in water, biota and food products on a routine basis. However, a comparison of known inputs of hazardous wastes (estimated at 42,000 tonnes/yr mainly in Winnipeg) as well as pesticide use (4.3×10^6 kg/yr mainly in S. Manitoba), with lists of chemicals monitored (Appendix 3 and 8) indicates some major chemical inputs are not monitored. Some of the more widely used pesticides (triallate, bromoxymil) and known toxic components of liquid wastes, e.g. chlorinated hydrocarbon solvents and polyaromatic hydrocarbons, are not determined. As the EMD moves towards greater control of hazardous wastes, there is likely to be an increased need to identify and monitor these materials in soil, water and air prior to and following disposal. Since most chemical components of hazardous wastes are not well identified, there is a need for the capability to determine unknown chemicals, especially organic chemicals. None of the agencies involved in monitoring chemicals in the province appears well equipped to determine unexpected or unknown contaminants.

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TABLE 1
Estimate of total quantities of various classes of hazardous wastes generated in Winnipeg, Manitoba and the net amount which require improved long term methods of disposal or treatment.

All amounts in liters unless shown as kilograms

WASTE CLASSIFICATION	AMOUNTS FOUND IN SURVEY	% OF TOTAL	ESTIMATE OF TOTAL WASTES GENERATED	NET AMOUNTS WHICH REQUIRE OTHER DISPOSAL METHODS OR TREATMENT
Flammable Solvents (liquids)	348 259	90	386 112	124 918
Acids, and Alkalies (liquids)	779 795	90	927 426	-
Sludges mixtures solids and liquids	30 844 kg 2 434 020	50	61 689 kg 4 921 035	61 689 kg 45 425
Waste Oil (liquids)	3 637 781	95	3 823 2660	-
Miscellaneous Chemicals (solids) (liquids)	6 350 kg 16 329	90 70	7 257 kg 196 841	3 628 kg 79 949
TOTALS			68 946 kg 10 254 681	65 317 kg 249 837

from Inventory of Hazardous Wastes generated in the city of Winnipeg 1981. Joint City Provincial Task Force for Hazardous Waste Disposal

PARTIAL LIST OF COMMITTEES CONCERNED WITH ENVIRONMENTAL QUALITY

Prairie Provinces Water Board

Red River Water Pollution Control Board

Manitoba Water Services Board

Western Canada Technical Committee on LRTAP (Long-range transport of air pollutants)

Terrestrial Effects Sub-Committee of Federal-Provincial Long Range Transport of Air Pollutants (LRTAP) Coordinating Committee.

Soils and Geology Sensitivity Mapping Commission of Western Canada, LRTAP Technical Committee.

Pesticide Residue Committee

Canadian Association of Pest Control Officials

Pesticide Sub-committee of the Manitoba Agriculture Services Coordinating Committee

Manitoba Arbovirus Surveillence Committee

Subcommittee of the Manitoba Arbovirus Surveillance Committee on effectiveness of aerial spraying for Western Equine Encephalitis control in Manitoba .

Manitoba Safety Council

National Advisory Committee on Environmental and Occupational Health

Policy Committee for Low Level Radioactive Waste

Manitoba Working Group of the Canada Ecological Committee

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APPENDIX 1

Provincial and federal water quality monitoring locations

LOCATION (Provincial)	IDENTIFICATION	SAMPLING FREQUENCY	PARAMETERS
Apussigamasi Lake	422	6/8 times/year	2
Athapapuskow L. at Bakers Narrows	088	"	2
Assiniboine R. at T.C.H.	015	Monthly	1
Assiniboine R. at Headingley	018	Monthly	1
Assiniboine R. at Brandon	009	Monthly	1 & 5
Assiniboine R. at Holland	013	Monthly	1
Assiniboine R. at Miniota	005	Monthly	1
Assiniboine R. at Portage la Prairie	391	Monthly	1 & 5
Assiniboine R. at Russell	363	Monthly	1
Bird R. at Bird Lake	387	Monthly	1
Barrington R.	389	6-8 times/year	2
Boyne R. at Carman	030	Monthly	1
Boyne R. at Stephanfield	026	Monthly	1
Brokenhead R. at Beausejour	392	Monthly	1
Burntwood R. at Thompson	093	6-8 times/year	2
Cedar L. at Easterville	383	"	3
Cedar L. at Oleson Point	161	"	3
Churchill R. at Granville Lake	385	"	2
Cocheram L. at Lynn Lake Mine	095	"	2
Cross L. at Cross L. Settlement	442	"	3
Cypress R. at Cypress River	398	Monthly (Mar.-Oct.)	1
Dauphin R. at Anama Bay	404	Monthly	1
Edwards Creek at Dauphin	399	Monthly (Mar.-Oct.)	1
Fairford River at Fairford	364	Monthly	1
Fishing R. at Fork River	223	Monthly (Mar.-Oct.)	1
Footprint R. at Nelson House	050	6-8 times/year	3
Garland R. at Duck River	231	Monthly (Mar.-Oct.)	1
Grass R. at Wakusko Falls	381	6-8 times/year	4
Herbet Lake	413	"	4
Joubert Creek at St. Pierre	395	Monthly(Mar.-Oct.)	1
Marsh River at Otterburne	365	"	1
Mink River at Ethelbert	221	"	1
Minnedosa R. at Minnedosa	099	Monthly	1
Minnedosa R. at Rivers	105	Monthly	1
Moose L. at Moose L. Settlement	160	6-8 times/year	3
Morris River at Rosenort	366	Monthly (Mar.-Oct.)	1
Mossey R. at Dauphin Lake	390	Monthly	1
Nelson R. at Norway House	049	6-8 times/year	3
Nelson R. at Sipiwesk Lake	048	"	3
Nelson R. at Split Lake	047	"	3
Ospwagan Lake at Thompson	362	"	2
Pembina R. at Rock Lake	400	Monthly	1
Pembina R. at LaRiviere	401	Monthly	1
Rat R. at Otterburne	394	Monthly	1
Rat River at Sundown	126	Monthly	1
Red River at Emerson	133	Open Water Only	5
Red River at Floodway	367	Monthly	1 & 5
Red River at Provencher St. (Hpg.)	368	Monthly	1
Red River at Selkirk	142	Monthly	1 & 5
Red River at St. Agathe	369	Monthly	1
Red Lake (N.E. Area)	421	6-8 times/year	2
Eldon Lake	559	6-8 times/year	2
Shell River at Shevlin	558	Monthly	1
Shell River at P.R. 589	411	Monthly	1
Riviere Aux Marais	396	Monthly (Mar.-Oct.)	1
Riviere Sale at Sanford	070	Monthly	1
Roaring R. at Minitonas	236	Monthly (Mar.-Oct.)	1
Roseau R. at Dominion City	393	Monthly	1
Rusty Lake Outlet	058	6-8 times/year	2
Rusty Lake Inlet	418	"	2
Saskatchewan R. at Grand Rapids	163	"	3
Saskatchewan R. at The Pas	384	"	3
Schist Lake	087	"	2
Seine R. at Prairie Grove	370	Monthly	1
Seine R. at Ste. Anne	402	Monthly (Mar.-Oct.)	1
Shell R. at Inglis	172	Monthly	1
Snake L. Outlet	419	6-8 times/year	2
Souris R. at Souris	371	Monthly (Mar.-Oct.)	1 & 5
Souris R. at Wawanesa	388	Monthly	1
South Indian Lake at Settlement	051	6-8 times/year	3
Turtle River at Laurier	403	Monthly (Mar.-Oct.)	1
Valley River at Dauphin	250	"	1
Valley River at Grandview	247	"	1
Vermillion R. at Dauphin	252	"	1
Wekusko Lake at Anderson Bay	382	6-8 times/year	4
Wekusko Lake at Herb Bay	420	"	4
Whitemouth R. at Whitemouth	386	Monthly	1
Whitemouth R. at Neepawa	201	Monthly (Mar.-Oct.)	1
Whitemud River at Westbourne	197	Monthly	1
Whiteshell R. at Jessica Lake	207	Monthly	1
Wilson River at Dauphin	255	Monthly (Mar.-Oct.)	1
Winnipeg R. at Lac du Bonnet	213	Monthly	1 & 5
Winnipeg R. at Point du Bois	210	Open Water Only	5

SAMPLING LOCATION (Federal)			
Antler River near Coulter	A	Monthly	
Badger Creek near Cartwright	B	Monthly	
Churchill River at Red Head R.	C	Quarterly	s
Cochrane R. at Brochet	D	Quarterly	e
Gainsborough Cr. at Hwy. 83	E	Monthly	e
Hayes R. below jct.with Gods R.	F	Quarterly	
Manigotogan River at Hwy 304	G	Monthly	p
Nelson River above Weir R.	H	Quarterly	a
Overflowing R. at Overflowing	I	Monthly	g
Pembina R. at Windygates	J	Monthly	e
Pine Creek Diversion at Hwy. 89	K	Monthly	
Pipestone Creek near Cromer	L	Monthly	35
Red River at Emerson	M	Monthly	
Roseau R. at Gardenton	N	Monthly	
Saskatchewan R. above Carrot R.	O	Monthly	
Souris River at Coulter	P	Monthly	
Swan River at Hwy. 10	Q	Monthly	
Winnipeg River at Point du Bois	R	Monthly	
Woody River at Hwy. 10	S	Monthly	

1. Conductivity, non-filtrable residue, pH, dissolved oxygen, total organic carbon, total inorganic carbon, turbidity, total Kjeldahl nitrogen, nitrate and nitrite nitrogen, total phosphorus.
2. Conductivity, non-filtrable residue, pH, arsenic, cadmium, copper, lead, nickel, zinc, dissolved oxygen, turbidity, total Kjeldahl nitrogen, nitrate and nitrite nitrogen, total phosphorus, mercury, alkalinity, calcium, magnesium, total organic carbon, total inorganic carbon.
3. Conductivity, non-filtrable residue, pH, dissolved oxygen, total organic carbon, total inorganic carbon, turbidity, total Kjeldahl nitrogen, nitrate and nitrite nitrogen, total phosphorus, mercury, alkalinity, calcium, magnesium.
4. Conductivity, non-filtrable residue, pH, arsenic, cadmium, copper, lead, nickel, zinc, dissolved oxygen, turbidity, total Kjeldahl nitrogen, nitrate and nitrite nitrogen, total phosphorus, mercury, free cyanide, alkalinity, calcium, magnesium, total organic carbon, total inorganic carbon.
5. Other tests.

Appendix 1. continued

Parameters measured for Federal Water Quality Stations in 1982.

	ANTLER R	BADGER R	CHURCHILL R	COCHRANE R	GAINSBOROUGH C	HAYES R	MANIGOTOGAN R	NELSON R	OVERFLOWING R	PEMBINA R	PINE C	PIPESTONE C	RED R	ROSEAU R	SASKATCHEWAN R	SOURIS R	SWAN R	WINNIPEG R	WOODY R
temperature	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
specific conductivity	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
pH	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
turbidity	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
apparent colour	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
true colour	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
nonfiltrable residue	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
fixed nonfiltrable residue	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	•	•	•	•
chlorophyll a	x	x	•	•	x	•	x	•	•	x	x	x	x	x	x	•	x	x	•
total coliforms	x	x	•	•	x	•	x	•	•	x	x	x	x	x	x	•	x	x	•
fecal coliforms	x	x	•	•	x	•	x	•	•	x	x	x	x	x	x	•	x	x	•
dissolved oxygen	x	x	•	•	x	•	x	•	x	x	x	x	x	x	x	x	x	x	x
carbonate	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
alkalinity	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
bicarbonate	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
calcium, magnesium	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
hardness	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
total dissolved solids	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
sodium, potassium	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
chloride, fluoride	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
sulfate	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
silica	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
phosphorus-total	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
-dissolved	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
-particulate	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
nitrogen -NO_2 and NO_3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
-dissolved	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
-particulate	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
-total	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
-ammonia	x	x	•	•	x	•	x	•	•	x	x	x	x	x	x	x	•	x	•
carbon -dissolved inorganic	•	x	x	x	•	x	x	x	x	x	x	•	x	x	x	x	x	x	•
-dissolved organic	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
-org. particulate	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
-total organic	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
extractable -Al	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	•	•	•	•
-Mn	•	•	x	x	•	x	•	x	x	x	•	•	x	x	x	x	•	x	•
-Fe	•	•	x	x	•	x	•	x	x	•	•	•	x	x	x	x	•	x	•
-V	•	•	x	x	•	x	•	x	x	x	•	•	x	x	x	x	•	x	•
-Cr	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	x	•	•	•
-Co	•	•	x	x	•	x	•	x	•	•	•	•	x	x	x	x	•	x	•
-Ni	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	•	•	•	•
-Cu	•	•	x	x	•	x	•	x	x	x	•	•	x	x	x	x	•	x	•
-Zn	•	•	x	x	•	x	•	x	x	x	•	•	x	x	x	x	•	x	•
-Cd	•	•	•	x	•	x	•	x	•	x	•	•	x	x	x	x	•	x	•
-Ba	•	•	x	x	•	x	•	x	x	x	•	•	x	x	x	x	•	x	•
-Pb	•	•	x	x	•	x	•	x	x	x	•	•	x	x	x	x	•	x	•
dissolved B	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
As	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Se	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mn	x	x	•	•	x	x	x	•	x	x	x	x	x	x	x	x	x	x	x
CN	•	•	•	•	•	•	•	•	x	•	•	x	x	x	x	x	•	x	•
Fe	x	x	•	•	x	x	x	•	x	x	x	x	x	x	x	x	x	x	x
total Hg	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
total recoverable V	•	•	x	x	•	x	•	x	x	x	•	x	x	x	x	x	•	x	•
Co	•	•	x	x	•	x	•	x	x	x	•	x	x	x	x	x	•	x	•
Ni	•	•	x	x	•	x	•	x	x	x	•	x	x	x	x	x	•	x	•
Cu	•	•	x	x	•	x	•	x	x	x	•	x	x	x	x	x	•	x	•
Zn	•	•	x	x	•	x	•	x	x	x	•	x	x	x	x	x	•	x	•
Cd	•	•	x	x	•	x	•	x	x	x	•	x	x	x	x	x	•	x	•
Ba	•	•	x	x	•	x	•	x	x	x	•	x	x	x	x	x	•	x	•
Pb	•	•	x	x	•	x	•	x	x	x	•	x	x	x	x	x	•	x	•
phenolic material	•	•	•	•	•	•	•	•	x	x	•	x	x	x	x	x	•	x	•
n - alkanes	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	•	•	•	•
aromatic hydrocarbons	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	•	•	•	•
oil and grease	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	•	•	•	•
n - alkyd surfactants	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	•	•	•	•
organochlorines (suite)	•	•	•	•	x	•	•	x	x	•	x	x	x	x	x	•	x	•	•
dissolved uranium	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	x	•	•	•
radium radiation	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	x	•	•	•
tritium radiation	•	•	•	•	•	•	•	•	•	•	•	•	•	•	x	x	•	•	•

APPENDIX 2

1980 public water supply systems

Altona
Angusville
Arborg
Austin
Baldur
Barrows
Beausejour
Belmont
Benito
Binscarth
Birch River
Birtle
Bissett
Boissevain
Bowsman
Brandon
Camperville
Carman
Cartier
Cartwright
Churchill
Clearwater
Cold Lake
Cormorant
Cranberry Portage
Crane River
Cromer
Cross Lake
Dauphin
Deloraine
Dominion City
Duck Bay
Dunrea
Easterville
Eden
Elie
Elm Creek
Emerson
Erickson
Ethelbert
Falcon Lake
Flin Flon
Forrest
Gilbert Plains
Gillam
Gimli
Gimli Indust. Park
Gladstone
Gods Lake Narrows
Goodlands
Grandview
Great Falls
Gretna
Grunthal
Hamiota
Hartney
High Bluff
Holland
Ilford
Inglis
Kelwood
Kenton
Killarney
Kleefeld
Kola
Lac du Bonnet
Landmark
Leaf Rapids
Letellier
Lorette (Benjamin)
Lorette (Friedman)
Lorette (Gagnon)
Lyleton
Lynn Lake
McCreary
MacDonald
MacGregor
Mallard
Manitou
Medora
Melita
Miami
Minitonas
Minnedosa
Moose Lake
Morden
Morris
Neepawa
Nelson House
Norway House
Notre Dame
Oak River
Oakville
Pierson
Pikwitonei
Pilot Mound
Pinawa
Pine Falls
Plum Coulee
Point du Bois
Portage La Prairie
Rapid City
Rathwell
Reston
Rivercrest
Rivers
Roblin
Roland
Rossburn
Russell
St. Agathe
St. Claude
St. George
St. Jean
St. Lazare
St. Leon
St. Rose.
Sandy Lake
Selkirk
Seven Sister Falls
Sherridon
Shoal Lake
Shore Point Village
Sinclair
Snow Lake
Somerset
Souris
South Indian Lake
Steinback
Stonewall
Strathclair
Swan Lake
Swan River
The Pas
Thicket Portage
Thompson
Tilston
Treherne
Victoria Beach
Virden
Wabowden
Warrens Landing
Waskada
Waterhen
Wawanesa
Westbourne
West Hawk Lake
White Horse Park
Winkler
Winnipeg
Winnipeg Beach
Winnipegosis

APPENDIX 3

Water quality parameters measured by the Inland Waters Directorate (Environment Canada)

1. Temperature, total and faecal coliform, conductivity, non-filterable residue, pH, dissolved oxygen, total organic carbon, total inorganic carbon, total Kjeldahl nitrogen, nitrate-nitrite, total phosphorus
2. Parameters #1 plus arsenic, cadmium, copper, lead, nickel, zinc and mercury, minus total organic carbon and total inorganic carbon
3. Parameters # 1 plus mercury.
4. Parameters #2 plus cyanide (free)
5. Biomonitoring (sampled only during open water). Population dynamics of phytoplankton, zooplankton and benthos, heavy metal and organics on fish and on sediments as required
6. pH, turbidity, color, conductivity, dissolved oxygen, temperature
7. Total coliform, faecal coliform
8. Alkalinity, calcium, chloride, fluoride, hardness, magnesium, potassium, silica, sodium, sulfate, total dissolved solids
9. Dissolved organic carbon, particulate organic carbon, total organic carbon, dissolved inorganic carbon, particulate nitrogen, dissolved nitrogen, total nitrogen, dissolved phosphorus, total phosphorus, nitrate and nitrite
10. Barium, cadmium, cobalt, copper, iron, manganese, lead, zinc, vanadium, nickel
11. Boron, selenium, arsenic
12. Organochlorines, PCB's phenoxy acid herbicides, pyridines, phenols
13. Miscellaneous - mercury, cyanide, non-filterable residue, etc.

APPENDIX 4

Locations of Shoal Lake water quality monitoring stations

1. Indian Bay (intake)
2. Indian Bay (between intake and island)
3. Indian Bay (Manitoba/Ontario boundary
4. Narrows Channel
5. Presbyterian Camp
6. Twin Point
7. Dominique Island
8. Stevens Island
9. Clytie Bay
10. Cash Island
11. Long Island
12. Falcon River

APPENDIX 5

Water quality monitoring sites on rivers and streams in Winnipeg

Red River	Floodway Control
	South Perimeter Bridge
	Fort Garry Bridge
	Norwood Bridge
	Redwood Bridge
	North Perimeter Bridge
	Lockport Bridge
Assiniboine River	Headingley
	West Perimeter Bridge
	Main Street Bridge
Seine River	Highway 59
	Provencher Boulevard
Sturgeon Creek	Perimeter Highway
	Portage Avenue
Omand's Creek	Portage Avenue
LaSalle River	Highway 75
Bunns Creek	Henderson Highway

APPENDIX 6

Distribution system monitoring - City of Winnipeg

Frequency: (October 1 - April 30) bi-weekly
(May 1 - September 31) weekly

Sample Site

1. Henderson Hwy./Leighton Ave.
2. Regent Ave./Plessis Road
3. Autumnwood Dr./#1 Highway
4. St. Marys Rd./Parkville Dr.
5. Osborne St./Kylemore Ave.
6. Dalhousie Dr./Silverstone Ave.
7. Pembina Hwy./Ducharme Ave.
8. Tuxedo Ave./Corydon Ave.
9. Roblin Blvd./Dale Blvd.
10. Ness Ave./Setter St.
11. Ness Ave./Woodlawn St.
12. King Edward St./Tyndall Ave.
13. Jefferson Ave./Adsum Dr.
14. Maple St./MacDonald Ave.
15. Bannerman Ave./Salter St.
16. McGregor St./Partridge Ave.
17. McIvor Ave./Rothesay St.
18. Portage Ave./Lenore St.

Parameters:

Free/total chlorine
turbidity
temperature
fluoride (Distribution System Composite)

APPENDIX 7

Manitoba ambient air monitoring network

STATION LOCATION	SITE CODE	PARAMETERS MONITORED									
		SULFUR DIOXIDE	HYDROGEN SULFIDE	CARBON MONOXIDE	OZONE	NITROGEN DIOXIDE	SOILING INDEX	TOTAL PARTICULATE & LEAD	SULFATE	NITRATE	OTHER
65 Ellen Street Winnipeg	70119	X*		X*	X*	X*	X*	X*	X*	X*	chromium, cadmium, arsenic
299 Scotia Street Winnipeg	70118	X*		X*	X*	X*	X*	X*	X*	X*	
2120 Portage Avenue Winnipeg	70102							X*	X*	X*	
800 Marion Street Winnipeg	70104							X*	X*	X*	
604 St. Mary's Rd. Winnipeg	70120	X*		X*	X	X	X*	X*	X*	X*	
1350 Pembina Hwy. Winnipeg	2011							X			
MTS Building St. Francois Xavier	4304							X			
1011 Mission St. Winnipeg	0793	X	X								
Fournier & Panet Winnipeg	0803	X									
1104 Princess St. Brandon	70201							X*	X*	X*	
Assiniboine C. College Brandon	5131	X			X	X	X	X	X	X	nitric oxide
City Hall Flin Flon	7211	X									
Channing Drive Flin Flon	7222	X									
Provincial Building The Pas	7111		X								
59 Elizabeth Road Thompson	7344	X									
Martin & Henderson Winnipeg	70105										sulfation rate* dustfall*
Kennedy & St. Mary's Winnipeg	70110										dustfall*
Portage & Minto Winnipeg	70115										sulfation rate*
Windermere & Rockman Winnipeg	70113										sulfation rate* dustfall*
Smith & King Winnipeg	70116										sulfation rate* dustfall*
Exp. Farm Morden	70117										sulfation rate* dustfall*
Weather Station Island Lake											precipitation sampling
Weather Station Norway House											precipitation sampling

*Data reported to National Air Pollution Surveillance (NAPS)

March, 1981

APPENDIX 8

Analyses performed by the Environmental Management Division's W.M. Ward Technical Service Laboratory

PARAMETER		WATER				BIOLOGICALS				AIR	SEDIMENTS	SOIL		
		SURFACE	GROUND	WASTE	ACID RAIN	VEGETATION	FISH & ANIMAL TISSUE	BLOODS & URINES						
ACIDITY		X	X	X	X									
ALKALINITY		X	X	X	X								HOG MANURE	X
ARSENIC		X	X	X		X	X	X			X			
ASBESTOS										X				
AUTOMATE BLUE #10 DYE													GASOLINE	X
BAYGON		X												
BENTHOS											X			
BENZENE SOLUBLES										X				
BIOASSAY		X												
BOD		X		X									HOG MANURE	X
BORON		X	X	X										
BUTANOL										X				
CADMIUM	TOTAL			X		X	X			X	X	X		
	EXT.	X	X	X										
CALCIUM		X	X	X	X									
CARBON	TIC	X	X	X										
	TOC	X	X	X										
CARBON MONOXIDE										X				
CHEMICAL OXYGEN DEMAND				X									BUTTER	X
CHLORIDE		X	X	X	X	X							HOG MANURE	X
CHLOROPHYLL a		X												
CHROMIUM	TOTAL													
	HEX													

APPENDIX 8 continued

PARAMETER		WATER				BIOLOGICALS			AIR	SEDIMENTS	SOIL	
		SURFACE	GROUND	WASTE	ACID RAIN	VEGETATION	FISH & ANIMAL TISSUE	BLOODS & URINES				
COBALT	TOTAL	X	X	X			X					
	EXT	X	X	X								
COLOUR		X	X	X								
COPPER	TOTAL	X	X	X	X	X	X		X	X	X	
	EXT	X	X	X								
CYANIDE	TOTAL	X	X	X								
	FREE	X	X	X								
DIETHOTATE									X			
DISSOLVED OXYGEN		X	X	X								
DUSTFALL									X			
DYES	RODAMINE B	X	X	X								
	URININE	X	X	X								
ETHYL ACETATE									X			
ETHYL OXIDE									X			
FLAMMABILITY												MAN MADE MATERIALS X
FLOW CALIBRATIONS									X			
FLUORIDE		X	X	X		X			X			
FORMALDEHYDE									X			
FUEL OIL		X	X	X								
GASOLINE		X	X	X								
HERBICIDE	2,4D	X	X				X					
	2,4,5T	X	X				X					
HERBICIDE	SILVEX	X	X				X					
	2,4DB	X	X				X					
HYDROGEN SULFIDE		X	X	X					X			

APPENDIX B continued

PARAMETER		WATER				BIOLOGICALS				AIR	SEDIMENTS	SOIL		
		SURFACE	GROUND	WASTE	ACID RAIN	VEGETATION	FISH & ANIMAL TISSUE	BLOODS & URINES						
IRON	TOTAL	X	X	X	X	X				X	X	X		
	EXT.	X	X	X										
KEROSENE		X	X	X										
LEAD	TOTAL	X	X	X	X	X	X	X		X	X	X		
	EXT.	X	X	X										
MAGNESIUM		X	X	X	X									
MANGANESE		X	X	X				X						
MERCURY	TOTAL	X	X	X		X	X	X			X			
	EXT.	X	X	X										
NICKEL	TOTAL	X	X	X	X	X	X			X	X	X		
	EXT.	X	X	X										
AMMONIA NITROGEN		X	X	X	X									
NITRATE-NITRITE		X	X	X	X					X				
TOTAL KJELDAHL NITROGEN		X	X	X									HOG MANURE	X
NITROGEN OXIDES										X			STACK GAS	X
OIL & GREASE		X	X	X										
OZONE										X				
TOTAL SUSPENDED PARTICULATE										X				
PENTACHLOROPHENOL		X	X	X								X		
pH		X	X	X	X							X	HOG MANURE	X
TOTAL-PHOSPHATE		X	X	X									HOG MANURE	X
ORTHO-PHOSPHATE		X	X	X										
PHYTOPLANKTON		X												
POTASSIUM		X	X	X									HOG MANURE	X

APPENDIX 8 continued

PARAMETER		WATER				BIOLOGICALS			AIR	SEDIMENTS	SOIL		
		SURFACE	GROUND	WASTE	ACID RAIN	VEGETATION	FISH & ANIMAL TISSUE	BLOODS & URINES					
POLY CHLORINATED BIPHENYLS	AROCLOR 1248	X	X				X			X		OILS	X
	AROCLOR 1254	X	X				X			X		OILS	X
	AROCLOR 1260	X	X				X			X		OILS	X
PESTICIDES ORGANO-CHLORINATED (O.C.'s)	LINDANE	X	X				X			X			
	ALDRIN	X	X				X			X			
	HCB	X	X				X			X			
	HEPTACHLOR EPOXIDE	X	X				X			X			
HEPTACHLOR		X	X				X			X			
CIS CHLORDANE		X	X				X			X			
TRANS CHLORDANE		X	X				X			X			
p,p' DDE		X	X				X			X			
DIELDRIN		X	X				X			X			
o, p' DDE		X	X				X			X			
ENDRIN		X	X				X			X			
MIREX		X	X				X			X			
TREFLAN		X	X				X			X			
p,p'DDD		X	X				X			X			
o,p'DDD		X	X				X			X			
o,p'DDT		X	X				X			X			
TECHNICAL CHLORDANE		X	X				X			X			
p,p'DDT		X	X				X			X			
METHOXYCHLOR		X	X				X			X			
RESIDUES	TOTAL	X	X	X								HOG MANURE	X
	NON-FILTERABLE	X	X	X									
	FILTERABLE	X	X	X									
	FIXED TOTAL	X	X	X									

APPENDIX 8 continued

PARAMETER		WATER				BIOLOGICALS			AIR	SEDIMENTS	SOIL	
		SURFACE	GROUND	WASTE	ACID RAIN	VEGETATION	FISH & ANIMAL TISSUE	BLOODS & URINES				
RESIDUES Cont.	FIXED NON-FILTERABLE	X	X	X								
	FIXED FILTERABLE	X	X	X								
	NON-SETTEABLE	X	X	X								
	SETTEABLE	X	X	X								
SELENIUM		X	X	X								
SILICA		X	X	X								
SODIUM		X	X	X	X							
SPECIFIC CONDUCTANCE		X	X	X	X							HOG MANURE X
STYRENE									X			
SULFATE		X	X	X	X	X			X			
SULFUR DIOXIDE									X			STACK GAS X
THALLIUM		X	X	X								
TURBIDITY		X	X	X								
VINYL CHLORIDE		X	X	X					X		X	
ZINC	TOTAL	X	X	X	X	X	X		X		X	
	EXT.	X	X	X								
ZOOPLANKTON		X										

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